THE GROUND-BEETLES OF THE AZORES (COLEOPTERA: CARABIDAE) [1]

By CARL H. LINDROTH [2]

The *Carabidae* collected by Drs. P. Brinck and E. Dahl, assisted by their wives, in the Azores February to April 1957 amounted to almost 700 specimens, belonging to 20 different species, of which *Tachys micros* Fisch., was new to the islands.

Our knowledge of the Carabid fauna of these islands has been summarized not long ago by two French authors, G. Colas (1939) and A. Méquignon (1942). Only one substantial contribution has been published since, the paper by Uyttenboogaart (1947), based on material collected in 1938 by R. Frey, R. Storå and C. Cedercreutz of the Helsingfors University.

It thus would seem superfluous to give, on this occasion, more than a short list of the new data. However, as some of the older records seemed doubtful, or the species were imperfectly known, I decided to revise the entire Carabid fauna of the islands, consisting of no more than 32 species altogether, one or two of which were purely accidental. A few general remarks on the composition and the history of the Carabid fauna have been added.

Thanks to the courtesy of the officials of several museums, as well as of private collectors, I have been able to study Azorean specimens of all species reported from the islands and, in dubious casas, also material from other regions, necessary for comparison. These gentlemen are: — Mr. E. B. Britton, British Museum (Nat. Hist.), London; Dr. L. Brundin and Mr. E.

---

1) Report No. 4 from the Lund University Expedition in 1957 to the Azores and Madeira

2) Zoological Institute of the University of Lund, Sweden.

Kjellander, Riksmuseum, Stockholm; Mr. G. Colas, Muséum National d'Histoire Naturelle, Paris; Dr. C. Conci, Museo Civico dj Storia Naturale, Milano; Dr. W. Hackman, Zoological Museum of the University, Helsingfors; Dr. F. Janczyk, Naturhistorisches Museum, Wien; Dr. G. Müller, Via Ressman 2, Trieste.

I refrain from giving here a historical review of the coleopterological exploration of the Azores. Méquignon (1942) has given a complete bibliography of all the earlier publications.

The references given under each species are of records from the Azores. The occurrence on the Iberian Peninsula is quoted from Fuente (1918-21).

1. *Calosoma olivieri* Dejean

Drouet, 1859, p. 252; 1861, p. 187; Tarnier, 1860, p. 89; Bedel, 1895, p. 20; Alluaud, 1919, p. 251; Breuning, 1927, p. 225; Colas, 1939, p. 42; Jeannel, 1940, p. 117; Méquignon, 1942, p. 6; Uyttenboogaart, 1947, p. 2.

azoricum Heer, 1860, p. 5; Wollaston, 1865, p. 4; Crotch, 1867, pp. 365, 366; 1870, p. 58; Alluaud, 1891, pp. 199, 207.

Taxonomy. I have compared a ♂ from Terceira (Mus. Hfors) with a ♂ from Las Palmas, Canaries, a ♂ from Algeria, and a ♀ from Tunisia.

The Azorean form was originally described as a distinct species, *azoricum* (Heer, 1860), tentatively kept separate from *olivieri* Dej. as late as Alluaud (1891, cf. 1919), but synonymized by Bedel (1895). The identity has been confirmed by later revisors (Breuning, Jeannel).

Distribution. Santa Maria; São Miguel; Terceira; Flores; Corvo:

Canaries. Cap Verde Islds. (Not known from Madeira.)

N. Africa: Morocco - Egypt. W Asia. (Unknown in Europe.)

Dynamics. The species is constantly long-winged and no doubt an excellent flyer.

2. *Bembidion (Neja) ambiguum* Dejean

hesperus Crotch, 1867, pp. 369, 382; 1870, p. 63 (nec *hesperum* Fall 1910)[1]; Bedel, 1896, p. 57; Colas, 1939, p. 42; Méquignon, 1942, p. 8; Netolitzky, 1942-43, pp. 71, 86.

---

1) Crotch's «*hesperus*» is apparently thought a noun, Fall's «*hesperum*» (Trans. Amer. Ent. Soc. 36. 1910, p. 95) an adjective. Whatever the case may be, this difference does not suffice and Casey's proposal (Mem. on the Coleopt. 8. 1918, p. 9), to change Fall's name to «*hesperium*», should be accepted.

Taxonomy. Crotch (1867) compared his new species with *B. (Testedium) laetum* Brullé, to which it has no relation. It has later been placed in the subgenus *Diplocampa* (*vide* Netolitzky 1942-43, p. 86). Méquignon (1942) pointed out the close affinity to *ambiguum* Dej.

I have studied one of the «co-types» (♂) of *hesperus* (Brit. Mus.) and made a genital slide. The outer form of the penis and the very complex armature of the internal sac agree exactly with those of an *ambiguum* ♂ from Tanger (det. Netolitzky, Mus. Wien). In a ♂ from Malta (Mus. Wien) there are minor, certainly not specific, differences in details of certain spines of the internal sac.

Distribution. *Terceira*, Praia, 2 specimens («co-types»), «under marine rejectamenta», apparently on April 21st, 1865 (*vide* Crotch, 1867, p. 360). The introduced *Licinus punctatulus* F. was also found only here and apparently on the same day.

N. Africa: Morocco — Tripolis. — Portugal; S. Spain.

Western Mediterranean region.

Dynamics. In the three specimens examined the hind-wings are reduced to narrow rudiments, about half the length of the elytra.

3. *Bembidion (Peryphus) derelictum* Alluaud

Alluaud, 1926, p. 11; Colas, 1939, p. 42; Méquignon, 1942, p. 8; Netolitzky, 1942-43, pp. 45, 123.

Taxonomy. Alluaud (1926), in his original description, erected the new, monotypic subgenus *Protoperyphus* which was retained by Netolitzky (*loc. cit.*). However, it is clear from a footnote (p. 45) that Netolitzky himself had never seen the species. Méquignon (1942): «Endemique de forme très particulière justifiant la création d'un sous-genre, ou peut-être même d'un genre spécial».

I have been able to examine a ♂ «co-type» (Mus. Paris) and the following notes may serve to supplement the original description: — The microsculpture is dense and rather strong over the entire upper surface: on the head irregularly isodiametric, on prothorax and elytra consisting of very dense transverse lines, with a tendency of joining into irregular, very broad meshes (average more than twice the length). No iridescence. — The head has a group of small, irregular punctures at the proximal end of the frontal furrows. — The metasternal process between the middle coxae (fig. 2) is narrow, marginated. The impressed furrow is obsolete at the middle

and proceeds forward less than in *B. yukonum* Fall (*grapeioides* Mnst., Lindroth, 1939-40, p. 78) for instance, but more so than in *B. sigma* Lth. (1943, p. 8). — Aedeagus. The large left paramere has 3 apical setae, the right 2 apical and 1 subapical. The internal sac of the penis (fig. 3) has a complex armature which, among species known to me, shows the greatest resemblance to *B. grapei* Gyll. and notably *B. yukonum* Fall (Lindroth, 1939-40, figs. 17 a. f.). The most remarkable details in common are a stylet (S) and a flagellum (G). These structures seem to be characteristics of the entire group around *B. nitidulum* Mrsh., as defined by Netolitzky (1942-43, p. 38 a. f.). In part the penis of these species was figured by de Monte (1943).

From the above it is reasonable to conclude that *derelictum* is a true member of the subgenus *Peryphus* and though it is closely related to no other known species, there seems to be no reason to retain for it a separate subgeneric name.

Distribution. Known only from the two original specimens (sex not stated); *Flores*, «sur une hauteur à l'Est de la Caldeira Comprida», 31.VII.1888 (according to the label).

Dynamics. In the examined ♂ the wings are rudimentary, narrow, parallel-sided, length about one half, width about one third of one elytron.

4. ***Bembidion (Nepha) schmidti*** Wollaston

callosum, Drouet, 1859, p. 254; 1861, p. 191; Tarnier, 1860, p. 90.
schmidti, Crotch, 1867, pp. 364, 369; 1870, p. 63; Colas, 1939, p. 42; Méquignon, 1942, p. 7; Lundblad, 1958, p. 462.

Taxonomy. *B. schmidti* was first described by Wollaston (1854, p. 80) from Madeira, the closely related *subcallosum* (1864, p. 71) from the Canaries. The Azorean form was first referred to the Mediterranean *callosum* Küst., later identified with the Madeiran *schmidti*.

An investigation of the ♂ genitalia shows that the Azorean form (2 specimens, São Miguel) is conspecific with both the Madeiran *schmidti* (1 specimen, Mus. Wien) and the Canarian *subcallosum* (2 specimens, Mus. Wien). The two latter have already been specifically joined in a recent, excellent revision by de Monte (1952, p. 85 a. f.), together with *alluaudi* Antoine, 1925 (Morocco) and *jeanneli* Dewailly, 1951 (Alpes Maritimes, Pyreneans, Corsica) I have seen neither of the two Continental forms but as de Monte based his opinion upon a careful investigation of the penis, there is no reason to doubt its correctness.

I am also able to confirm de Monte's statement that *callosum* Küster, 1847, with its forms, is a different pecies. In 2 ♂♂ from Sardinia (*loc. class.*, Mus. Wien) the penis, in side-view, has a perfectly straight ventral side (de Monte, *loc. cit.*, fig. 9, p. 91) but it is sinuate near the apex in all forms of *schmidti* (*loc. cit.*, figs. 13-16). In the armature of the internal sac I could find no differences between the three Macaronesian forms, whereas in *callosum* from Sardinia almost all details, though fundamentally the same, are different.

Externally, the Azorean form runs closer to the Madeiran *schmidti* than to *subcallosum* but is sufficiently distinct to be recognized as a separate subspecies, hitherto undescribed. The three Macaronesian forms of *schmidti* are:—

a. *schmidti* Woll. s. s. (Madeira). Prothorax (fig. 4) with blunt hind-angles. Elytra parallel-sided with more pronounced shoulders, the striae fading out in the apical half but traceable to apex. L. 4.3-4.5 mm.

b. *schmidti azoricum* n. sbsp. (Azores). Prothorax (fig. 5) with sides sinuate basally, as well as the base inside the hind-angles, which therefore are prominent, forming a right or slightly acute angle. Elytra more oviform with less pronounced shoulders; the striae as in *forma typica*. L. 4.0-4.9 mm. — ♂ holotype, ♀ allotype, and 14 paratypes, all from São Miguel, III.1957 (Mus.Lund).

Colas (1939,p.42) described an Azorean form with lacking anterior pale spot of elytra as «*méquignoni*, n.var.» It deserves no name. As a rule, however, the subhumeral spot is darker and less defined in the subspecies *azoricum* than in *forma typica*.

c. *schmidti subcallosum* Woll. (Canaries). Smaller on an average, prothorax narrower, hind-angles as in *forma typica*. Elytra less oviform than in the subspecies *azoricum*, the striae, except the sutural one, completely disappearing behind the middle. L. 3.5-4.4 mm.

The small carina (German «Feldchen») inside the hind-angles of the prothorax, often used as a distinctive character against *B. genei* Küst., seems to be little constant in *schmidti s. l.* At least this is true for all three insular subspecies here treated. In these the carina is sometimes practically lacking, as observed by Netolitzky (1942-43, p. 103, footnote) on a specimen from Madeira.

New material. *São Miguel:* Lagoa das Furnas 10.III. (Loc. 22), 2 specimens; Furnas, 11.III. (Loc. 24), 5 specimens (incl. ♀ allotype); Lagoa do Fogo, 22.III. (Loc. 54), 2 specimens: NW Agua Retorta, 23.III. (Loc. 57), 7 specimens (incl. ♂ holotype); Maia 25.III. (Loc. 62), 1 specimen.

Distribution (sbsp. *azoricum*) São Miguel (also Drouet, 1859). Faial (Crotch, 1870). — For distribution of the other subspecies of *schmidti* Woll., see above.

Ecology. All 17 specimens from 1957 were taken among gravel at the edges of lakes and streams.

Dynamics. The wings are seemingly full in all investigated specimens of *schmidti s. l.* (and *callosum* Küst.). The narrowed shoulders in the subspecies *azoricum*, however, might give rise to suspicions that this form, at least, is not capable of flight.

5. ***Bembidion (Ocys) harpaloides*** Serville

(*dubium* Woll.)

rufescens, Drouet, 1859, p. 254; 1861, p. 191; Tarnier, 1860, p. 90; Crotch, 1867, pp. 364, 369; 1870, p. 63.
harpaloides, Bedel, 1896, p. 71; Netolitzky, 1916; Colas, 1939, p. 42; Jeannel, 1941, p. 449; Méquignon, 1942, p. 7; Uyttenboogaart, 1947, p. 2; Lundblad, 1958, p. 462.

Taxonomy. The Azorean specimens are quite typical, completely agreeing with specimens from the British Isles. They are unusually varying in size: 4.0-5.5 mm.

New material. *Santa Maria,* Almagreira, 19.III. (Loc. 39), 1 specimen. —*São Miguel,* Sete Cidades. 2.III. (Loc. 7), 2 specimens, 8.III. (Loc. 18), 1 specimen, 21.III. (Loc. 51), 1 specimen; Feteiras, 2.III. (Loc. 5), 1 specimen; Relva, 15.III. (Loc. 31), 2 specimens; Lagoa do Congro, 16. III. (Loc. 34), 7 specimens; Lagoa das Furnas, 10.III. (Loc. 22), 6 specimens; Furnas, 11.III. (Loc. 24), 2 specimens; Agua Retorta, 23.III. (Loc. 57), 3 specimens.—*Faial,* Praia do Norte, 2.IV. (Loc. 79), 1 specimen; Porto do Salão, 1.IV. (Loc. 75), 3 specimens; Flamengos, 4.IV. (Loc. 91), 2 specimens.— *Flores,* S of Caldeira Comprida, 14.IV. (Loc. 109), 1 specimen.

Distribution. Santa Maria; São Miguel; Faial; Flores. — Madeira.

N. Afr.: Morocco — Tunisia. — Portugal; Spain. — Brit. Isles.

Mediterranean region, W Europe N to Scotland and, isolated, in SW Norway.

Ecology. The Azorean specimens were taken on moist soil near water, usually under vegetable refuse. In Europe on dark, moist places, under the bark of logs, etc.

Dynamics. The hind-wings are fully developed and no doubt functional.

6. ***Tachys (Tachyura) parvulus*** Dejean

(*diabrachys* Kolenati 1845, *curvimanus* Wollaston 1854)

quadrisignatus, Crotch, 1867, pp. 364, 369; 1870, p. 62.
parvulus, Schatzmayr, 1940, p. 82.
diabrachys, Méquignon, 1942, p. 7; Lundblad, 1958, p. 462.[1]

Taxonomy. Both *diabrachys* Kol. and *curvimanus* Woll. have long been regarded as colour forms (or subspecies) of *parvulus* Dej. (e. g. by Schatzmayr & Koch, 1934, p. 15; Schatzmayr, 1940, p. 81-82). Jeannel (1941, p. 438) joined them under the name of *diabrachys* which, however, he regarded as specifically distinct from *parvulus*. Besides differences in colour, he emphasizes the presence of three (instead of two) apical setae of the large left paramere in *diabrachys*.

I have studied genital slides of the following ♂♂:—Azores, São Miguel and Santa Maria, 3 specimens; Madeira, 1 «co-type» of *curvimanus* Woll. (Brit. Mus.); 1 authentic Kolenati specimen (apparently a «co-type») of *diabrachys* from Transcaucasus [2] (Mus. Wien); 1 normal *parvulus* from Hungary (Mus. Wien). — Among these specimens I can find no differences in outer form or inner armature of the penis. In all specimens, except the one from Hungary (with mutilated parameres), the left paramere has two apical setae only; the number of 3 in the ♂ from Corsica drawn by Jeannel (1941, p. 436, fig. 172 e) may be an individual abnormity.

The colour of the elytra gives little evidence for subspecific differentiation. As already mentioned by Schatzmayr (1940), Azorean specimens may be either clearly spotted or almost plain dark brown; the anterior spot may disappear completely and the preapical represented only by an obscurely delimited, reddish brown area. This, on the other hand, is sometimes present even in true *parvulus* from the European mainland.

New material. *Santa Maria*, Aeroporto, 19-20.III. (Loc. 44,45), 1 specimen.—*São Miguel*, Lagoa das Furnas, 10.III. (Loc. 22), 4 specimens; Ribeira Grande, Caldeiras, 14.III. (Loc. 28), 2 specimens.—*Faial*, Praia do Almoxarife, 31.III. (Loc. 72), 1 specimen; Ribeira do Faial, 26.IV. (Loc. 129), 1 specimen.

Distribution. Santa Maria; São Miguel; Terceira; Faial. — Madeira; Porto Santo. Canaries. Cape Verdes

---

1) The «*curvimanus*» of Uyttenboogaart (1947, p. 2) = *T. micros* Fisch.

2) I do not understand why Jeannel *(loc. cit.)* gives «Syrie» as type locality of *diabrachys*. In the original description (Kolenati, 1845, p. 72) only the rivers Alasan and Jora in the Caucasus are mentioned.

N. Afr.: Algeria—Egypt.—Portugal; Spain.—British Isles.

S & C Europe, N to Brandenburg. W Asia.—Introduced in NW North America.

Ecology. On the Azores among vegetable drift on sea-shore and under leaves near a hot spring. — In Europe on sandy soil, usually at the edge of standing or running waters.

Dynamics. The hind-wings are full in all investigated specimens.

7. ***Tachys (s. str.) micros*** Fischer

«*curvimanus*», Uyttenboogaart, 1947, p. 2 (*nec* Wollaston).

Taxonomy. This species is seemingly new to the Azorean fauna but it was published by Uyttenboogaart *(loc. cit.)* as «*curvimanus*». From the closely related *bistriatus* Dft. it is distinguished externally by a laterally less oblique prothorax base and, consequently, sharper, almost rectangular hind-angles. Also, the microsculpture of the head is stronger in *micros*. The general form of the penis is quite different (Jeannel, 1941, p. 429, figs. 169 b & c), as confirmed on one Azorean ♂ and one of *bistriatus* from *loc. class.* (Vienna; Mus. Wien).

New material. *São Miguel*, Charco da Madeira, I.III. (Loc. 4), 2 specimens.—*Faial*, Pedro Miguel, 5. IV. (Loc. 92), 21 specimens.

Distribution. São Miguel; Faial; Flores; — Canaries (Schatzmayr & Koch, 1934, p. 10). From Madeira only *T. bistriatus* has been reported of this species group (2 specimens seen; Brit. Mus.).

N. Afr.: Algeria — Tripolis. — Spain (not recorded from Portugal).

S & C Europe, N to Hamburg. Caucasus. — The species seems to have widened its European area in recent years (Horion, 1941, p. 168).

Ecology. On Faial many specimens were taken on a flooded pasture at the margin of an artificial pond. — In Europe usually in the vicinity of fresh water, often under deep-lying stones.

Dynamics. According to Jeannel *(loc. cit.)* the ♂ of *micros* is probably constantly «aptère», the ♀ long-winged — a very unusual case among Carabidae. However, all the Azorean specimens are macropterous, regardless of sex.

8. ***Trechus torre-tassoi*** Jeannel

Jeannel, 1937, p. 84; Schatzmayr, 1940, p. 83; Colas, 1939, p. 43; Méquignon, 1942, p. 7.

Taxonomy. The careful original description, accompanied by drawings

of habitus and the ♂ genitalia, needs no complement. The Azorean species is closely related to certain Madeiran species around *flavomarginatus* Woll. (Jeannel, *loc. cit.*).—I have seen 2 ♂, 1 ♀ from the *loc. class.*, preserved at the Museo Civico, Milano; 1 specimen is in Mus. Paris; all collected by A. Schatzmayr. The original sample thus consisted of 4, not of 2 specimens (cf. Jeannel, *loc. cit.*).

Distribution. The single locality known is Sete Cidades, a volcanic mountain in westernmost *São Miguel*, 4.VI.1935.

Dynamics. The hind-wings are reduced to almost inconspicuous rudiments.

9. ***Perigona nigriceps*** Dejean

fimicola Woll. (gen. *Trechus* or *Trechicus*), Crotch, 1867, pp. 364, 369; 1870, p. 62.
nigriceps, Colas, 1939, p. 43; Jeannel, 1942, p. 581; Méquignon, 1942, p. 8; Lundblad, 1958, p. 463.

Taxonomy. I have seen only one Azorean specimen, quite typical, from São Miguel, published by Uyttenboogaart (1947, p. 3) as «*Acupalpus luridus* Dej.» (Mus. Hfors).

Distribution. São Miguel; Faial.—Madeira. Canaries. Cape Verdes.

?N. Africa.—Portugal; Spain.—British Isles.

Almost cosmopolitan, geographical origin probably in S Asia. In Europe N to S Sweden. The species has increased its area considerably in recent times.

Ecology. This is a species favoured by human influence occurring in all kinds of decomposing vegetable matter, particularly in gardens and parks.

Dynamics. The hind-wings are well developed and flight has often been observed (e. g. Jeannel, *loc. cit.*).

10. ***Licinus punctatulus*** Fabricius

(*silphoides* F., *nec.* Rossi)

brevicollis, Crotch, 1867, pp. 363, 367; 1870, p. 58.
punctatulus, Colas, 1939, p. 43; Jeannel, 1942, p. 995; Méquignon, 1942, p. 13.

Taxonomy. One of Crotch's specimens (♂, Brit. Mus.) was studied. It is a typical *punctatulus* F., *sensu* Jeannel (*loc. cit.*).

Distribution. *Terceira*, Praia, abundant, apparently on April 21, 1865 (*vide* Crotch, 1867, p. 360); never found again. «Its localization suggests that it may have been imported with ballast» (Crotch, 1870).

N. Africa: Morocco — Tunisia. — Spain (not reported from Portugal). — British Isles (S Engl.).

Mediterranean region, S & W Europe, N to Hannover. — Occasionally introduced in E North America.

Ecology. Apparently a xerophilous species, occurring in dry, open country.

Dynamics. The wings seem to be fully developed but it is uncertain wehther they can be used for flight.

11. ***Harpalus (Ophonus) ardosiacus*** Lutshnik

(*rotundicollis* Fairm. 1854, *nec* Kolen. 1845, *nec* Mtsch. 1848)

obscurus, Drouet, 1859, p. 254.
rotundicollis, Drouet, 1861, p. 190; Tarnier, 1860, p. 90; Crotch, 1867, pp. 364, 368; 1870, p. 60; Jeannel, 1942, p. 642; Méquignon, 1942, p. 8.
diffinis var. *rotundicollis,* Alluaud, 1891, pp. 200, 207; Bedel, 1899, p. 142.
ardosiacus, Colas, 1939, p. 43; Uyttenboogaart, 1947, p. 2.
ardosiacus and *stictus,* Lundblad, 1958, p. 463.

Taxonomy. A ♂ from Faial and a ♀ from São Miguel agree with current descriptions (Schauberger, 1926, pp. 160, 165; 1932, p. 62-63; G. Müller, 1931, p. 45-46; Jeannel, 1942, p. 641) and were compared with ♂♀ from S England. Whether *opacus* Dej. (*silicicola* Antoine) is specifically distinct, I have been unable to determine (cf. Jeannel, *loc. cit.*).

Lundblad (1958) listed this species twice from the Azores, once under the name of «*stictus* Steph.», which is a synonym of *obscurus* F. (*vide* Horion, 1941, p. 207, and Jeannel, *loc. cit.*).

New material. *Santa Marta,* limestone area, 20.III. (Loc. 48), (fragment) —*São Miguel,* 3 km. S Pico da Pedra, 25.III (Loc. 64), 1 specimen.—*Faial,* Praia do Norte, 2.IV. (Loc. 79), 1 specimen.

Distribution. Santa Maria; São Miguel; Terceira; Faial; Flores. — Madeira. Salvages.

N. Africa: Morocco — Tunisia. — Portugal; Spain. — British Isles. S & W Europe, N to N France and Austria.

Ecology. Apparently a xerophilous species, in Europe occurring on open, often calcareous and more or less culture-influenced soil.

Dynamics. The hind-wings are full and no doubt functional.

12. ***Harpalus (Pseudophonus) rufipes*** De Geer

(*pubescens* O. F. Müller)

ruficornis and *griseus,* Drouet, 1859, p. 254; 1861, p. 190; Tarnier, 1860, p. 90; Crotch, 1867, pp. 363, 368; 1870, p. 61.
pubescens, Alluaud, 1891, pp. 200, 207; Bedel, 1899, p. 145; Colas, 1939, p. 43; Jeannel, 1942, p. 654; Méquignon, 1942, p. 9; Uyttenboogaart, 1947, p. 2; Lundblad, 1958, p. 463.

Taxonomy. The 27 specimens seen are generally below average size, some very small, but always with pronounced hind-angles of prothorax and ventral segments with normal punctuation and pubescence. In earlier times small specimens of *rufipes* were often confused with *griseus* Panz. in Europe.

De Geer's name *rufipes* (1774) has priority over *pubescens* O. F. Müller (1776).

New material. *São Miguel,* Caldeira das Sete Cidades (fragm.); Ribeira Grande (fragm.); Ribeirinha, 25.III. (Loc. 63), 2 specimens; Maia, 25.III. (Loc. 62), 1 specimen; Ribeira da Praia, 13.III. (Loc. 27), 1 specimen; Lagoa das Furnas, 10.III. (Loc. 22), 6 specimens; Furnas (fragments). — *Terceira,* Angra, 28.III. (Loc. 70), 1 specimen — *Faial,* Costa da Nau, 4.IV. (Loc. 88), 1 specimen; Praia do Norte, 2.IV. (Loc. 79), 3 specimens; Ribeira das Cabras (fragments); Ribeirinha, 1.IV. (Loc. 73), 2 specimens.

Distribution. São Miguel; Terceira; Pico; São Jorge; Faial; Graciosa; Flores. — Madeira.

N. Africa: Morocco, Algeria. — Portugal; Spain. — British Isles.

Almost the entire Palaearctic region.—Introduced in N. America.

Ecology. In Europe this is a typical inhabitant of cultivated ground, also in towns and ports; as a rule very abundant.

Dynamics. The wings are full and flight has been observed on several occasions in Europe.

13. ***Harpalus*** (s. s.) ***distinguendus*** Duftschmid

Drouet 1859, p. 254; 1861, p. 191; Tarnier, 1860, p. 90; Crotch, 1867, pp. 364, 368; 1870, p. 61; Alluaud, 1891, pp. 200, 207; Bedel, 1898, p. 133; Jeannel, 1938, p. 10; 1942, p. 669; Colas, 1939, p. 43; Méquignon, 1942, p. 9; Uyttenboogaart, 1947, p. 3; Lundblad, 1958, p. 463.

Taxonomy. The 23 specimens seen, green or slightly brassy, are quite normal.

New material. *Santa Maria, i. a.* Praia and Valverde, 20.III. (Loc. 47, 49), 5 specimens.—*São Miguel,* Relva, 15.III. (Loc. 32), 3 specimens; Ponta Del-

gada, 3-4.III. (Loc. 9), 3 specimens; Pico da Pedra, 25.III. (Loc. 64), 1 specimen; Vila Franca do Campo, 28.II. (Loc. 2), 2 specimens.—*Terceira*, Praia da Victoria, 27.III. (Loc. 69), 1 specimen; Angra, 28.III. (Loc. 70), 3 specimens.—*Faial*, Horta, 7 IV. (Loc. 94), 4 specimens. — *Pico*, São João, 9.IV. (Loc. 103), 1 specimen.

Distribution. Santa Maria; São Miguel; Terceira; Pico; S. Jorge; Faial; Flores; Corvo. — Madeira; Porto Santo.

N. Africa: Morocco, Algeria. — Portugal; Spain. — (*Not* in the British Isles.)

Palaearctic region, N to C Scandinavia, E to River Lena.

Ecology. This is a pronouncedly xerophilous species, inhabiting open gravelly soil with low, sparse vegetation of weeds and grass. In Europe often in towns and ports; clearly favoured by cultivation.

Dynamics. The wings are full and flight has been observed many times in Europe.

14. ***Anisodactylus binotatus*** Fabricius

Drouet, 1859, p. 254; 1861, p. 190; Tarnier, 1860, p. 90; Crotch, 1867, pp. 364, 368; 1870, p. 60; Alluaud, 1891, pp. 200, 207; Bedel, 1899, p. 148; Jeannel, 1938, p. 9; 1942, p. 608; Colas, 1939, p. 43; Méquignon, 1942, p. 8; Uyttenboogaart, 1947, p. 3; Lundblad, 1958, p. 464.

Taxonomy. All 16 specimens seen are quite normal and belong to the black-legged typical form.

New material. *S. Miguel*, Sete Cidades, 8.III. (Loc. 18), 5 specimens; Feteiras, 6.III. (Loc. 12), 1 specimen; Relva, 15.III. (Loc. 31), 1 specimen; Lagoa das Furnas, 10.III. (Loc. 22), 6 specimens; Furnas, 11.III. (Loc. 24), 1 specimen. — *Terceira*, Angra, 28.III. (Loc. 70), 1 specimen. — *Faial*, Cedros, 5.IV. (Loc. 93), 1 specimen.

Distribution. São Miguel; Terceira; Graciosa; Faial; Flores; Corvo. — Madeira. Cape Verdes.

N. Africa: Morocco, Algeria. — Portugal; Spain. — British Isles.

Palaearctic species, N to C Scandinavia, E to W Siberia. — Introduced in NW North America.

Ecology. In Europe on open, not too dry ground, often in the vicinity of fresh water; regularly on cultivated soil.

Dynamics. The wings are full. Flight has been observed repeatedly in Europe.

15. ***Stenolophus teutonus*** Schrank

(*vaporariorum* F.)

vaporariorum, Drouet, 1859, p. 254; 1861, p. 191.
teutonus, Tarnier, 1860, p. 90; Wollaston, 1865, p. 49; Crotch, 1867, pp. 364, 368; 1870, p. 61; Alluaud, 1891, pp. 201, 207; Bedel, 1899, p. 154; Colas, 1939, p. 44; Jeannel, 1942, p. 697; Méquignon, 1942, p. 9; Uyttenboogaart, 1947, p. 3; Lundblad, 1958, p. 463.

Taxonomy. Azorean specimens agree with those from the European continent. The complex armature of the internal sac of the penis is identical in 2 ♂♂ from the Azores (Santa Maria; São Miguel) and 1 ♂ from Denmark (Sjaelland). In the ♂ from São Miguel the penis apex is considerably shorter than figured by Jeannel *(loc. cit.),* in the others agreeing.

Colas (1939) lists also «var. *abdominalis* Gené» from the Azores. This is a separate species (Schauberger, 1935, p. 277)[1] with different penis form (Jeannel, *loc. cit.*) and Colas was probably misled by the fact that certain Azorean specimens have the abdomen slightly paler (reddish) on the sides. This colour character has no specific significance; the «var. *pseudoabdominalis* Schaub.» of *teutonus* has the abdomen entirely red.

New material. *Santa Maria,* Valverde, 20.III. (Loc. 49), 1 specimen.— *São Miguel,* Sete Cidades, 8.III. (Loc. 18), 1 specimen, 21.III. 1 specimen; Relva, Nascente dos Lagos, 15.III. (Loc. 32), 14 specimens; Ribeirinha, 25.III. (Loc. 63), 1 specimen. — *Faial,* Ribeira dos Flamengos, 31.III. (Loc. 71), 1 specimen.

Distribution. Santa Maria; São Miguel; Terceira; Graciosa; Faial; Flores; Corvo. — Madeira. Canaries.

N. Africa: Morocco — Egypt. — Portugal; Spain. — British Isles.

Euromediterranean, N to S Sweden.

Ecology. The large series from Relva was collected on a steep, rocky slope with rather moist soil and low vegetation. In Europe on more or less open, gravelly soil with sparse vegetation and moderate moisture. Not confined to the vicinity of water.

Dynamics. The wings are full but no records of flight seem to be available.

---

1) Schauberger originally (1928, p. 84; 1930 b, p. 206) confused *abdominalis* Gené with *persicus* Mnh.

16. ***Acupalpus brunneipes*** Sturm

(*brunnipes* auct.)

brunnipes, Drouet, 1859, p. 254; 1861, p. 191; Tarnier, 1860, p. 90; Crotch, 1867, pp. 363, 368; 1870, p. 62.
brunneipes, Bedel, 1899, p. 158; Colas, 1939, p. 44; Jeannel, 1942, p. 722; Méquignon, 1942, p. 10; Uyttenboogaart, 1947, p. 3.

Taxonomy. Schauberger (1930a, p. 211), and after him Jeannel (1942, p. 722), adopted the name *atratus* Dej. (type area: Spain) for a southern subspecies of *brunneipes*, with pretended deviation through denser microsculpture, basally prolonged raised margin and more developed punctuation of the basal foveae of the prothorax. The two last-named features are individually varying within the same geographical area (for instance the Azores) and I am unable to confirm any consistent difference in microsculpture (Greece, 2 specimens; S Italy, 1 specimen: Germany, 4 specimens). At any rate the Azorean specimens do not differ in this respect from those from Germany (the type area of *brunneipes* Sturm). Unfortunately all 12 specimens seen from the Azores are ♀♀ so that the genitalia could not be checked.

New material. *Pico,* São João, 9.IV. (Loc. 103), 1 specimen.

Distribution. Santa Maria; São Miguel; Terceira; São Jorge; Pico; Flores.—(Not in the other Macaronesian islands.)

N. Africa: Morocco — Tunisia. — Portugal; Spain. — British Isles.

S & C Europe, N to N Germany.

Ecology. A hygrophilous species, in Europe mainly occurring on peaty soil.

Dynamics. Constantly long-winged and no doubt able to fly.

17. ***Acupalpus dubius*** Schilsky

(*luridus* auct., *nec* Dej.)

luridus, Crotch, 1867, pp. 363, 369; 1870, p. 62[1]; Uyttenboogaart, 1947, p. 3.
luteatus, Bedel, 1899, p. 158; Méquignon, 1942, p. 10; Lundblad, 1958, p. 464 (*nec* Dft.).
luteatus & *flavicollis,* Colas, 1939, p. 44; Jeannel, 1942, pp. 720, 721.

Taxonomy. This species was formerly named «*luridus* Dej.» (still so called by G. Müller, 1933, p. 204) but Schauberger has pointed out (1930a, p. 207) that Dejean's species, which in the original description (1829, p. 455) is

(1) Colas' quotation (1939) of Drouet for the Azorean «*luridus*» must refer to Crotch.

said to lack dorsal punctures on the elytra, is a synonym of *flavicollis* Sturm. This led to the wrong record of *flavicollis* from the Azores (Colas, Jeannel).

There is no doubt that the Azorean species is *dubius*. The penis of 2 ♂♂ from Faial and of 1 ♂ from the Crotch collection (Brit. Mus.) was compared with that of 1 ♂ of *dubius* from Poole, Dorset, Engl. (Mus. Lund) and of 1 ♂ of *luteatus* Dft. from Kistanje, Dalmatia (det. G. Müller, Mus. Lund). Besides in general form, as indicated by Jeannel (1942, p. 719, figs. 247 e, g) and Burakowski (1957, figs. III, 18, 19), the penis of *dubius* is characterized by a well-defined area of more heavily chitinized tooth-like papillae in the middle of the ventral part of the internal sac. In *luteatus* this area is only slightly darker, obscurely limited, with no transformation of the papillae.—As pointed out by Uyttenboogaart (1947), *dubius* differs from *luteatus* also in the more emarginate 4th segment of the pro-tarsi of the ♂.

New material. *Faial*, Pedro Miguel, 5.IV. (Loc. 92), 5 specimens.

Distribution. São Miguel; Terceira; Graciosa; Faial.—The records for «*luteatus*» from Madeira and the Canaries, as well as for «*luridus*» from Portugal and Spain (Fuente, 1919, p. 213) most probably belong to this species. The status of the N. African «*luteatus*» (Bedel, 1899, p. 158) is unknown.—British Isles.

Europe, N to S Sweden. Caucasus.

Ecology. The Faial specimens were collected on a flooded pasture near an artificial pond. It is a rather hygrophilous species, in Europe occurring among leaves, mosses etc., usually on more or less peaty soil.

Dynamics. The wings are always full and no doubt functional.

18. ***Bradycellus distinctus*** Dejean

distinctus azoricus, Crotch, 1867, p. 369; 1870, p. 62; Colas, 1939, p. 44; Méquignon, 1942, p. 9.
distinctus, Alluaud, 1891, pp. 200, 207; Bedel, 1899, p. 152; Jeannel, 1942, p. 708.

Taxonomy. Crotch (1867) tentatively erected the name «*azoricus*» (on the basis of 1 ♂ from São Miguel) but at the same time regarded the insect as probably introduced (*loc. cit.*, p. 363). Colas (1939) retained Crotch's name for a supposed endemic subspecies. I have compared Crotch's type (Brit. Mus.) with 10 specimens from S England. It has flatter elytral intervals and finer punctuation of the prothorax than any of the British specimens which, however, between themselves are not constant in these respects. Contrary to Colas (*loc. cit.* figs. 1 & 2) [the numbers should be reversed] I can find no differences in the penis; even the folding of the internal

sac are identical. Further material must be awaited before the status of the Azorean *distinctus* can be settled.

Distribution. *São Miguel*, Lagoa das Furnas (Crotch). *Graciosa* (Méquignon).—(Not on the other Macaronesian islands.)

N. Africa: Morocco — Tunisia. — Portugal; Spain. — British Isles

W Europe to N France, W Mediterranean region.

Ecology. In Europe usually on sandy soil near the sea.

Dynamics. The hind-wings are reduced into quite small rudiments in all investigated specimens.

19. ***Bradycellus chavesi*** Alluaud

Alluaud, 1919, p. 252; Colas, 1939, p. 44; Méquignon, 1942, p. 10.

Taxonomy. In the Paris Museum there is a ♀ («Açores, S. Miguel, Cap. Chaves»), remarkably enough labeled «paratype», though Alluaud expressly stated that his species was described from «un seul individu». This second specimen, which I was able to examine, agrees with the description and provided the opportunity for a few supplementary remarks.—*B. chavesi* undoubtedly comes very close to *distinctus*, as already stated by Alluaud, but, besides the deep piceous colour, is characterized by the rich development of hair-bearing punctures, not only on elytra and prothorax, but also on the head, especially laterally. Such punctures are present in *distinctus* only on the prosternum and the ventral segments of the abdomen where in *chavesi* they are much coarser and carry longer setae; the same applies to the three basal segments of the antennae. Though this general increase of pubescence may, theoretically, be the effect of one single gene, the difference in colour and in the narrower form of prothorax justifies to keep *chavesi* as a distinct species.

Distribution. Known only from São Miguel, in 2 specimens.

Dynamics. The hind-wings are quite rudimentary.

20. ***Pterostichus (Lagarus) vernalis*** Panzer

Drouet, 1859, p. 254; 1861, p. 190; Tarnier, 1860, p. 90; Crotch, 1867, pp. 363, 368; 1870, p. 60; Bedel, 1899, p. 186; Colas, 1939, p. 45; Jeannel, 1942, p. 742; Méquignon, 1942, p. 10; Uyttenboogart, 1947, p. 3.

Taxonomy. The single specimen seen is quite normal.

New material. *Faial*, Pedro Miguel, on a flooded pasture, 5.IV. (Loc. 92).

Distribution. São Miguel; Faial.—(Not in the other Macaronesian islands.)

N. Africa: Algeria. — Portugal; Spain. — British Isles.

Palaearctic, N to C Scandinavia, E to E Siberia.

Ecology. A hygrophilous species, favouring the margins of fresh water where the vegetation (Carices, etc.) is rich.

Dynamics. This species shwos wing-dimorphism though in the brachypterous form the hind-wings are not much reduced. The macropterous form is no doubt capable of flight. The investigated Azorean specimen has fully developed wings.

21. ***Pterostichus aterrimus*** Herbst

nigerrimus, Crotch, 1867, pp. 364, 368; 1870, p. 60.
aterrimus nigerrimus, Colas, 1939, p. 45; Jeannel, 1942, p. 764; Méquignon, 1942, p. 10; Uyttenboogaart, 1947, p. 3.
aterrimus, Lundblad, 1958, p. 464.

Taxonomy. The Azorean specimens belong to the subspecies *nigerrimus* Dej., deviating from *forma typica* in the following characters: (a) prothorax more narrowed towards base; (b) elytra shorter, less parallel-sided, with deeper striae and more convex intervals, especially laterally. As pointed out by Jeannel (*loc. cit.*) there are no differences in the ♂ genitalia and the two forms are certainly not specifically distinct. There is complete agreement between the 3 Azorean specimens seen and specimens from S Europe (i. a. Madrid). The ♂ described by Colas (*loc. cit.*; Riksmus. Sthlm.) is unusually small but otheriwse normal: ♂♀ from São Jorge (Mus. Hfors.) are of average size.

Distribution. Terceira; São Jorge. — Madeira; Porto Santo.

N. Africa: Morocco.—Portugal; Spain; S France.

The *forma typica* is more northern in distribution, E to W Siberia. Also on the British Isles.

Ecology. The species as a whole is strongly hygrophilous, occurring in marshes and at the border of fresh water, often on peaty soil.

Dynamics. The wings are full and large; flight has been observed in the *forma typica* (C Eur.).

22. ***Amara aenea*** De Geer

trivialis, Drouet, 1859, p. 254; 1861, p. 190; Tarnier, 1860, p. 90; Crotch, 1867, pp. 364, 368; 1870, p. 60.
aenea, Alluaud, 1891, pp. 201, 207; Bedel, 1899, p. 171-172; Jeannel, 1938, p. 11; 1942, p. 919; Colas, 1939, p. 45; Méquignon, 1942, p. 12; Uyttenboogaart, 1947, p. 3; Lundblad, 1958, p. 464.

Taxonomy. The 12 specimens seen are all quite normal, of a uniform, rather dark brassy colour. According to Méquignon (*loc. cit.*) also specimens with violaceous elytra occur in the Azores.

New material. *São Miguel*, Ponta Delgada, 1.III. (Loc. 4), 1 specimen, 15.III. 1 specimen; Lagoa do Congro, 16.III. (Loc. 34), 1 specimen; Maia, 25. III. (Loc. 62), 2 specimens. — *Terceira*, Angra, 28.III. (Loc. 70), 2 specimens. — *Faial*, Praia do Norte, 2.IV. (Loc. 79), 3 specimens; Horta (fragment). — *Pico*, Areia Larga, 11.IV. (Loc. 107), 1 specimen.

Distribution. São Miguel; Terceira; Pico; Faial; Graciosa; Flores; Corvo.—Madeira; Porto Santo.—Canaries.

N. Africa: Morocco—Tunisia.—Portugal; Spain.—British Isles.

Palaearctic, N to C Scandinavia, E to W Siberia. — Introduced in N. America

Ecology. Everywhere confined to dry, sunexposed fields with low, not too dense vegetation. Clearly favoured by human culture and often occurring in towns and ports.

Dynamics. The wings are always full and flight has often been observed.

Méquignon (1942, p. 13) reports the observation of an entirely different *Amara* (possibly of the subg. *Leirides*) on São Miguel. Unfortunately the specimen was lost.

Genus ***Calathus*** Bon.

This genus is the most interesting among Azorean Carabidae. It is represented by three forms, all belonging to the *melanocephalus-mollis* group. Actually, both *melanocephalus* L. (Uyttenboogaart, 1947) and *mollis* Mrsh. (Drouet, 1859; Tarnier, 1860; Crotch, 1867; etc.) have been reported from the islands, and also *erratus* Sahlb. (*flavipes* Payk.) (Drouet, 1859, 1861). However, none of the continental *Calathus* species occurs on the Azores, the three existing forms apparently being endemic. In my opinion they should all be treated as distinct species.

The Azorean *Calathus* are brachypterous whereas the true *mollis* Mrsh., of western Europe and N. Africa, seems to be constantly macropterous. On the other hand, the sbsp. *erythroderus* Gaut., of continental Europe, shows wing-dimorphism (Lindroth, 1949, pp. 340, 368 a. f.). Hypothetically, one or two long-winged ancestors of the three Azorean species may have arrived by air. The distance, for instance from the Iberian Peninsula, is not neces-

sarily too great; the isolated area of *mollis* s.str. in SW Norway is no doubt the result of a similar migration over sea from the south or southeast.

23. ***Calathus extensicollis*** Putzeys

mollis, (from Pico), Drouet, 1859, p. 253; 1861, p. 188.
extensicollis, Putzeys, 1863, p. 76; Bedel, 1900, p. 205 (footnote); Colas, 1938, p. 75; 1939, p. 46; Méquignon, 1942, p. 11.

Taxonomy. Putzeys' original description fits the specimens studied by Colas and myself, except that the prothorax is said to be «plus long que large». This is probably a *lapsus calami* (even in *C. vicenteorum* the proportions are reverse) and the description of the prothorax sides as «également rétréci en avant et en arrière» fits the present specie alone among known Azorean *Calathus*. The size is given as 8 mm. only by Putzeys (whose measurements, however, are generally not very accurate), as 9 mm. for the 5 specimens in Brit. Mus. studied by Colas (1938, p. 75). I have seen two of these, a ♂ measuring 11.1, a ♀ 10.8 mm. These discrepancies are probably more seeming than real.

C. extensicollis is much broader than the two following species, in particular the prothorax (fig. 10), with the index (length: width) 72-73; its sides are more rounded and more broadly depressed. — The microsculpture of the prothorax is entirely isodiametric, also on the disc. On the elytra it is denser in both sexes than in the two other species (and in *mollis*). — The apex of the penis (fig. 15) is almost straight (side view), dilated at tip (dorsal view) as in *mollis*. The right paramere is widened and strongly hooked at the apex.

This species holds a rather isolated position, manifested also by the foldings of the internal sac of the penis which form a pattern more deviating from that of *mollis*, than in *lundbladi* and *vicenteorum*.

The Madeiran *C. subfuscus* Woll. is slightly similar superficially but, according to an authentic ♂ (Brit. Mus.), has the prothoracal sides much less depressed and almost straight in the basal half. The genitalia are entirely different: the penis is very short with broad, spatulate, ventrally excavate apex; the right paramere broad without hook at tip.

Distribution. Apparently endemic of Pico. The type specimen was recorded from the Azores without further indication. The specimen(s) reported from Pico as «*mollis*» by Drouet (1859) could not be traced. The

2 specimens, out of 5, seen from the Brit. Mus. are labeled: «Ilha do Pico, 3150 ft., J. Balfour Brown».--The ecology is not known.

Dynamics. The hind-wings are quite reduced.

24. ***Calathus lundbladi*** Colas

mollis, (from São Miguel), Drouet, 1859, p. 253; 1861, p. 188; Crotch, 1867, pp. 363, 367; 1870, p. 59.
lundbladi, Colas, 1938, p. 73; 1939, p. 45; Méquignon, 1942, p. 11.
melanocephalus, Uyttenboogaart, 1947, p. 3.

Taxonomy. Head and prothorax similar to *mollis* (fig. 8) but the eyes a little smaller and flatter, prothorax slightly less transverse (index, length: width=82-87; in British *mollis*=71-82), with more broadly depressed sides. Microsculpture of prothorax as in *mollis* (i. e. isodiametric, except on the disc where the meshes are clearly transverse), also on the elytra very similar, though the more or less isodiametric meshes are slightly more irregular and only very little stronger in the ♀ (the difference between the sexes being more pronounced in *mollis*).—Penis (fig. 13) clearly different from that of *mollis* (fig. 11): in lateral view slenderer, with almost straight ventral side; apex curved ventrally, in dorsal view long, parallel-sided. Right paramere with faint hook at tip (exaggerated in Colas' drawing, 1938), almost as reduced as in sbsp. *erythroderus* Gaut. of *mollis* (Lindroth, 1943 a, p. 53, figs. 25 a, b).—L. 9.5-9.8 mm.

C. lundbladi, of the Azorean species, is the one most similar to *mollis* but it comes rather close to *vicenteorum* as well, distinguished by the characters mentioned under that species. The Canarian *simplicicollis* Woll. is externally similar (fig. 11) but the aedeagus is quite different (fig. 16), penis with well defined apical plate.

Investigated specimens: ♂ holotype (Riksmus. Sthlm.); ♂ of «*mollis*», Crotch (Brit. Mus.); ♀ of «*melanocephalus*», Uyttenboogaart (Mus. Hfors.).

Distribution. Confined to the island of São Miguel. The exact locality of the type specimen was not stated. Crotch (*loc. cit.*) reported 1 specimen from Lagoa das Furnas; the ♀ in Mus. Hfors. was captured on Pico da Vara, 23.V.1938; both localities in the eastern part of the island. — The ecology is unknown.

Dynamics. The hind-wings are reduced to quite small rudiments.

25. ***Calathus vicenteorum*** Schatzmayr

Schatzmayr, 1937, pp. 11, 39; Colas, 1938, p. 76; 1939, p. 46; Méquignon, 1942, p. 11.

Taxonomy. Eyes much flatter than in all other species of the *mollis*

group (fig. 9), prothorax narrower (index, length: width = 91), front-angles less protruding, sides narrowly depressed in basal half only. — Microsculpture as in *lundbladi* (and *mollis*), except that it is more regularly isodiametric on the elytra, and stronger, particularly in the ♀, which therefore is very dull. — Penis (fig. 14) shorter than in *lundbladi*, notably the apex in dorsal view. Right paramere similar. — L. 8.1-10.0 mm.

This species is closer related to *lundbladi* than to any other species known to me, but quite distinct.

Distribution. Described from a single ♀ from Santa Maria (holotype, collected 26.IV.1935, Mus. Civ. Milano, seen) and apparently confined to that island. The Swedish expedition captured 1 ♂, 3 ♀, 19.III.1957, on Pico Alto, el. 550-590 m.a.s., that is on the highest part of the mountain.

Ecology. The 4 specimens from Pico Alto were taken on Calluna heath.

Dynamics. The hind-wings are quite reduced.

26. *Pristonychus (Laemosthenes) complanatus* Dejean

alatus, Drouet, 1859, p. 253; 1861, p. 188; Tarnier, 1860, p. 89.
complanatus, Wollaston, 1865, p. 28; Crotch, 1867, pp. 363,367; 1870, p. 58; Alluaud, 1891, pp. 201, 207; Colas, 1939, p. 46; Jeannel, 1942, p. 856; Mequignon, 1942, p. 11; Lundblad, 1958, p. 464.

Taxonomy. The 40 specimens examined are of normal appearance.

New material. *Santa Maria*, Aeroporto, 19-20.III. (Loc. 44, 45), 1 specimen; Praia, 20.III. (Loc. 47), 1 specimen. — *São Miguel*, Relva, 15.III. (Loc. 31), 3 specimens; Ponta Delgada, 4.III. (Loc. 9), 5 specimens; Villa Franca, 28.II. (Loc. 2), 2 specimens; Lagoa do Congro, 16.III. (Loc. 34), 1 specimen; Lagoa das Furnas, 10.III. (Loc. 22), 2 specimens; Furnas (fragments); Maia, 25.III. (Loc. 62), 1 specimen; Ribeirinha, 25.III. (Loc. 63), 2 specimens; Povoação, 24.III. (Loc. 60), 1 specimen (nuper). — *Faial*, Horta, 31.III. (Loc. 71), 1 specimen; Costa da Náu, 4.IV. (Loc. 88), 3 specimen; Cabeço do Canto, 4.IV. (Loc. 89), 1 specimen. — *Pico*, São João, 9.IV. (Loc. 103), 6 specimens; Areia Larga, 9-11.IV. (Loc. 104), 7 specimens.

Distribution. Santa Maria; São Miguel; Graciosa; Pico; Faial; Flores. — Madeira; Porto Santo. Canaries. Cape Verde Islands.

N. Africa: Morocco — Tunisia. — Portugal; Spain. — British Isles.

Apparently a native of N. Africa, this species has been spread through trade over a great part of the world, i. a. to W N. America.

Ecology. Not found indoors on the Azores but most abundant on

sandy sea-shores, in places more or less influenced by human culture; also in the interior of the islands. In other parts of its wide area usually in and around human dwellings, stores, docks, etc., in towns and ports.

Dynamics. The wings seem to be constantly full, in the sense that they possess a reflexed apical part. But this is short, all the veins weak, little pigmented, and the width of the wing does not exceed that of one elytron. It thus seems clear that the insect is not capable of flight.

27. *Agonum ruficorne* Goeze

pallipes, Drouet, 1859, p. 253; 1861, p. 189.
albipes, Tarnier, 1860 p. 89: Crotch, 1867, pp. 363, 367; 1870, p. 59.
ruficorne, Alluaud, 1891, pp. 201, 207: Bedel, 1902, p. 218: Jeannel, 1938, p. 15; 1942, p. 876: Colas, 1939, p. 46; Méquignon, 1942, p. 11; Uyttenboogaart, 1947, p. 3; Lundblad, 1958, p. 464.

Taxonomy. According to Colas *(loc. cit.)* the Azorean specimens are slightly deviating «dans la taille et la forme du pênis». Compared with Scandinavian specimens, the hind-angles of prothorax are more protruding in the Azorean form and the apex of the penis is shorter. This may indicate subspecific differentiation but, if so, the southern subspecies has a wider distribution; specimens from England (Barnstaple, N Devon) are identical with the Azorean form in both characters mentioned.

New material. About 400 specimens from all the islands mentioned below, except São Jorge. It is the commonest ground-beetle of the islands.

Distribution. Santa Maria; São Miguel; Terceira; Pico; São Jorge; Faial; Flores. — Madeira. Canaries.

N. Africa: Morocco — Tripolis. — Portugal; Spain. — British Isles.

Europe and Mediterranean region, N to C Scandinavia. — Introduced in N. America.

Ecology. On the Azores this species occurs in great abundance from sea level to high altitudes in the vicinity of all kinds of fresh waters, though occasionally at considerable distance from the margin. In Europe it is more truly ripicolous and frequents the margins of both fresh waters and the sea, usually where the soil is clayish and the vegetation sparse or lacking.

Dynamics. The hind-wings are seemingly full, with reflexed apical part, but so small that they probably are non-functioning. Repeated attempts, on Swedish material, to induce flight by sun-exposure etc. gave no result (Lindroth, 1945, p. 89).

28. *Agonum marginatum* Linné

Drouet, 1859, p. 253; 1861, p. 190; Tarnier, 1860, p. 89; Crotch, 1867, pp. 363, 367; 1870, p. 59; Alluaud, 1891, pp. 201, 207; Bedel, 1902, p. 219; Colas, 1939, p. 46; Jeannel, 1942, p. 885; Méquignon, 1942, p. 12; Uyttenboogaart, 1947, p. 3; Lundblad, 1958, p. 464.

Taxonomy. Azorean specimens (19 specimens seen) are dull brassy, only in some individuals with slight greenish lustre. In no other respect are they different from Scandinavian specimens and I cannot confirm the opinion of Méquignon (*loc. cit.*) that the elytra have a coarser microsculpture. Their uneven intervals show the tendency mentioned by him to be more convex also in certain Scandinavian specimens. The ♂ genitalia are identical. There is no need for erecting an Azorean (or Macaronesian) subspecies.

New material. *São Miguel*, Sete Cidades, 2.III. (Loc. 7), 5 specimens; Lagoa do Fogo, 22.III. (Loc. 54), 1 specimen; Lagoa das Furnas, 10.III. (Loc. 22), 10 specimens.—*Terceira*, Lagoa do Ginjal, 27.III. (Loc. 66), 1 specimen.—*Faial*, Pedro Miguel, 5.IV. (Loc. 92), 1 specimen.—*Flores*, nr. Caldeira Comprida, 14.IV. (Loc. 109), 1 specimen.

Distribution. São Miguel; Terceira; Graciosa; Faial; Flores; Corvo.—Madeira. Canaries.

N. Africa: Marocco—Tunisia.—Portugal; Spain.—British Isles.

West-Palaearctic, N to C Sweden, E to Hither Asia.

Ecology. Most Azorean specimens were taken under drift on the gravelly shore of a lake. A strongly hygrophilous species, also otherwise confined to the margins of fresh waters and the sea-shore, hewre the soil is more or less clayish and some vegetation of grasses, Carices, etc., is present.

Dynamics. The hind-ings ware full and flight has been observed on the continent.

29. *Agonum mülleri* Herbst

parumpunctatum, Drouet, 1859, p. 253; 1861, p. 190; Tarnier, 1860, p. 89; Crotch, 1867, pp. 363, 367; 1870, p. 60.
mülleri, Bedel, 1902, p. 218; Colas, 1939, p. 46; Jeannel, 1942, p. 886; Méquignon, 1942, p. 12; Uyttenboogaart, 1947, p. 3.

Taxonomy. Azorean specimens (5 specimens seen) are of normal appearance.

New material. *São Miguel*, Sete Cidades, 8.III. (Loc. 18), 1 specimen; Relva, 15.III. (Loc. 31), 1 specimen; Ribeirinha, 25.III. (Loc. 63), 3 specimens.

Distribution. São Miguel; Terceira; Faial.—(Not on the other Macaronesian islands, nor in N. Africa.)

Portugal; Spain.—British Isles.

Palaearctic. N to C Scandinavia, E to W Siberia. — Introduced in N. America.

Ecology. In Europe it is a species clearly favoured by human culture, reaching maximum abundance on open, more or less clayish fields with moderately dense vegetation of weeds and grasses; often in towns and ports.

Dynamics. The wings are full and flight has been observed repeatedly in Europe.

30. ***Agonum aptinoides*** Tarnier

Tarnier, 1860, p. 91-92; Drouet, 1861, p. 188; Crotch, 1867, p. 367; 1870, p. 59; Bedel, 1902, p. 217; Alluaud, 1919, p. 253; 1926, p. 12; Colas, 1939, p. 46; Mèquignon, 1942, p. 12.

Taxonomy. On account of its isolated taxonomic position this is the most interesting of all Azorean ground-beetles. The careful descriptions of the species made by Tarnier (1860) and Alluaud (1919), as well as the habitus drawing published by Colas (1939), may be supplemented by the following notes based on a ♂ from Furnas, collected by L. Chopard (Mus. Paris).

The microsculpture is isodiametric on the head, quite regular on the frons. On the prothorax it consists of very dense and fine transverse lines, confluent into irregular meshes, at least twice as broad as long. On the elytra the transverse lines are much coarser, irregularly confluent into wide, in part almost isodiametric meshes. — The internal sac of the penis (fig. 6) contains several dark areas of stiff hairs, within a basal field developed as a dense bundle of rather long spines.

Because of its large size, the narrow prothorax, effaced shoulders and slender appendages *A. aptinoides* bears a superficial similarity to certain North American species (*angustatum* Dej., *hypolithos* Say, etc.) but it differs, among other things, by the deeply emarginate labrum, truncate apex and narrowly, quite evenly reflexed side-margins of the prothorax, straight basal margin and non-sinuate apex of the elytra and the presence of only two, little conspicuous dorsal punctures on the 3rd interval. The similar habitus, therefore, cannot be regarded as due to true relationship.

Already Tarnier (1860) suggested a new genus (*Pseudanchomenus;* syn. *Azoranchus,* Alluaud, 1919) for the Azorean species. At any rate it is justified to retain this name for a subgenus, monotypic as far as known. The supposed relationship with the Canarian *A. nichollsi* Woll. (Crotch, 1867; 1870) is not real, as judged from an authentic ♂ (Brit. Mus.).

Distribution. Known only from São Miguel, where it was first taken

near Ponta Delgada in the western part of the island by H. Drouet and A. Morelet, in 1857, then on August 10, 1896, a second specimen at Furnas in the east, and in August 1930 several specimens in the same place by L. Chopard. — The ecology is not known.

Dynamics. The hind-wings are reduced to a quite small, narrow rudiment.

31. ***Dromius meridionalis*** Dejean

Colas, 1939, p. 47; Jeannel, 1942, p. 1067; Mequignon, 1942, p. 13.

Taxonomy. The single specimen available (*Faial*, Ribeirinha, 1.IV. 1957; Mus. Lund) was compared with 2 specimens from England (Brit. Mus.) and found identical.

Distribution. São Miguel; Terceira; Faial. — (Not on the other Macaronesian islands.)

N. Africa: Morocco — Tunisia. — Portugal; Spain. — British Isles.

S & W Europe, N to Denmark.

Ecology. Like all other members of *Dromius s. str.* this species lives under the bark of trees, in N. Africa i.a. of Quercus and Platanus.

Dynamics. The hind-wings are full and no doubt functional.

32. ***Microlestes negrita*** Wollaston

maurus, Crotch, 1867, pp. 363, 367; 1870, p. 58; Colas, 1939, p. 47; Jeannel, 1942, p. 1089.[1]
negrita, Mequignon, 1942, p. 13; Schatzmayr, 1943, p. 133; Lundblad, 1958, p. 465.

Taxonomy. I have compared ♂♀ «co-types» of *negrita* from Madeira (Brit. Mus.) and several specimens of both sexes from the same island (Swed. Exped., 1957) with 2 ♂, 4 ♀ from the Azores (3 from the Crotch collection, Brit. Mus., 3 from the Swed. Exped.). In all ♂♂ the penis is identical and agrees both with the drawing by Holdhaus (1912, p. 31) and the more sketchy one given by Jeannel (1942, p. 1087).

The penis of *luctuosus* Holdh., checked on ♂♂ from Madeira (Swed. Exped., 1957), is much smaller and broader and the internal sac lacks the group of teeth characteristic of *negrita*. It is difficult to understand how Jeannel (1938, p. 17; 1942, p. 1088) could regard *luctuosus* as a «forme» of *negrita*. Apparently he did not know the true *luctuosus*; his drawing of the penis of «var. *luctuosus*» (1942, fig. 358 b), with «les dents du sac interne

1) The quotation of Drouet for *M. maurus* by Colas (1939) and Jeannel (1942) is wrong.

. . . . . réduites», seems to belong to *negrita*. — Concerning the variation in wing size, *vide* below.

New material. *Faial*, Horta, 2.IV. (Loc. 81), ♂ (brachypterous); Praia do Almoxarife, 31.III. (Loc. 72), ♂♀ (macropterous).

Distribution. São Miguel (Crotch; Schatzmayr); Faial. — Madeira [1]. Canaries.

N. Africa: Morocco—Tunisia.—Portugal; Spain.

Mediterranean region (only southernmost Europe), E to Caucasus.

Ecology. Probably an inhabitant of dry, open country.

Dynamics. As pointed out by Holdhaus (1912, p. 31) the size of the hind-wings varies a great deal in *negrita*. On Madeira it seems to be constantly brachypterous, with a wing length of about half the normal size. In the Mediterranean region full-winged specimens are predominating but a brachypterous form with a still more reduced rudiment is known from the Balcan Peninsula (Holdhaus, *loc. cit.*).

In the Azores the species is dimorphic. Of 6 investigated specimens, 2 (♂♀, Faial) are macropterous, the rest (♂, Faial; 3 ♀, São Miguel) brachypterous, with the reflexed part of the wing, outside the stigma, lacking. The rudiment is slightly varying in size: from possessing the width and almost the lenght, to about half width and half length of one elytron. The full-winged form is no doubt able to fly.

M. luctuosus has been considered as constantly macropterous (Holdhaus, *loc. cit.*; Jeannel, *loc. cit.*), but actually is likewise dimorphic: the brachypterous form has been reported from Hoggar in Sahara (Peyerimhoff, 1931, p. 16) and Italy (Schatzmayr, 1943, p. 133).

General remarks

The number of Carabid species found on the Azores is 32. Of these 7 are endemic, unknown from elsewhere. One subspecies (of *Bembidion schmidti*) is likewise endemic.

Distribution within the area

An outline of the distribution of the 32 species among the 9 Azorean islands is given in table 1.

It shows that most species (26) are known from the largest island, São Miguel, but this at the same time is the one most explored. Otherwise

(1) Jeannel's earlier statement (1938, p. 17) that *negrita* is endemic in Madeira, is due to his wrong quotation of Holdhaus (cf. Lundblad, 1958, p. 465).

Table 1. Distribution of Carabid beetles on the Azores.

	Flores	Corvo	Faial	Pico	S. Jorge	Graciosa	Terceira	S. Miguel	S. Maria	Wings
Calosoma olivieri Dej.	+	+	–	–	–	–	+	+	+	m
Bembidion ambiguum Dej.	–	–	–	–	–	–	+	–	–	b
B. derelictum All.	+	–	–	–	–	–	–	–	–	b
B. schmidti Woll.	–	–	+	–	–	–	–	+	–	(m)
B. harpaloides Serv.	+	–	+	–	–	–	–	+	+	m
Tachys parvulus Dej.	–	–	+	–	–	–	+	+	+	m
T. micros Fisch.	+	–	+	–	–	–	–	+	–	m
Trechus torre-tassoi Jea.	–	–	–	–	–	–	–	+	–	b
Perigona nigriceps Dej.	–	–	+	–	–	–	–	+	–	m
Licinus punctatulus F.	–	–	–	–	–	–	+	–	–	(m)
Harpalus ardosiacus Lutsh.	+	–	+	–	–	–	+	+	+	m
H. rufipes DeG.	+	–	+	+	+	+	+	+	–	m
H. distinguendus Dft.	+	+	+	+	+	–	+	+	+	m
Anisodactylus binotatus F.	+	+	+	–	–	+	+	+	–	m
Stenolophus teutonus Schrk.	+	+	+	–	–	+	+	+	+	m
Acupalpus brunnipes Sturm	+	–	–	+	+	–	+	+	+	m
A. dubius Schky.	–	–	+	–	–	+	+	+	–	m
Bradycellus distinctus Dej.	–	–	–	–	–	+	–	+	–	b
B. chavesi All.	–	–	–	–	–	–	–	+	–	b
Pterostichus vernalis Panz.	–	–	+	–	–	–	–	+	–	m
P. aterrimus Hbst.	–	–	–	–	+	–	+	–	–	m
Amara aenea Deg.	+	+	+	+	–	+	+	+	–	m
Calathus extensicollis Putz.	–	–	–	+	–	–	–	–	–	b
C. lundbladi Colas	–	–	–	–	–	–	–	+	–	b
C. vicentecorum Schatzm.	–	–	–	–	–	–	–	–	+	b
Pristonychus complanatus Dej.	+	–	+	+	–	+	–	+	+	b
Agonum ruficorne Gze.	+	–	+	+	+	–	+	+	+	(m)
A. marginatum L.	+	+	+	–	–	+	+	+	–	m
A. müllleri Hbst.	–	–	+	–	–	–	+	+	–	m
A. aptinoides Tarnier	–	–	–	–	–	–	–	+	–	b
Dromius meridionalis Dej.	–	–	+	–	–	–	+	+	–	m
Microlestes negrita Woll.	–	–	+	–	–	–	–	+	–	d
Number of species	14	6	19	7	5	8	17	26	10	
	14		26					27		

+ = occurrence; endemic species in bold-faced type.

State of the wings: m = macropterous (long-winged), (m) = ditto, wings possibly non-functioning, b = brachypterous (short-winged), d = dimorphic (both forms occurring).

no positive correlation between size or geographical situation of the individual island and richness of fauna can be observed.

It is more interesting to compare distribution within the Azores with presence or absence of functioning wings:

1	species	found	on	8	islands,	macropterous;		
4	»	»	»	7	» , all	»	[1];	
4	»	»	»	6	» , 3	»	,	1 brachypterous [2];
2	»	»	»	5	» , all	»	;	
3	»	»	»	4	» , all	»	;	
3	»	»	»	3	» , all	»	;	
6	»	»	»	2	» , 4	»	[3],	1 dimorphic [4], 1 brachypterous [5];
9	»	»	»	1	island, 1	»	[6],	8 brachypterous.

1) *Agonum ruficorne*, probably not flying.
2) *Pristonychus complanatus*, synanthropic.
3) *Bembidion schmidti*, possibly not flying.
4) *Microlestes negrita*.
5) *Bradycellus distinctus*.
6) *Licinus punctatulus*, probably not flying.

There is a clear negative correlation between distribution and lacking power of flight. The 7 endemic species are all flightless and all restricted to one single island, as far as known.

Historical groups

A division of the 32 Azorean Carabidae according to their supposed relative age on the islands and their probable mode of arrival may tentatively lead to a division into four groups.

(*1*) Introduced species (*11 - 17*):

Bembidion ambiguum
Tachys parvulus *
Perigona nigriceps *
Licinus punctatulus *
? *Harpalus ardosiacus*
H. rufipes *
H. distinguendus
Anisodactylus binotatus *
? *Stenolophus teutonus*
? *Acupalpus brunneipes*
? *Bradycellus distinctus*
? *Pterostichus vernalis*
Amara aenea *
Pristonychus complanatus *
Agonum ruficorne *
A. mülleri *
? *Dromius meridionalis*

* = European introductions in North America (9 species).

(2) Species probably arrived by air (7):

Calosoma olivieri
Bembidion harpaloides
Tachys micros
Acupalpus dubius
Pterostichus aterrimus
Agonum marginatum
Microlestes negrita

(3) Neo-endemic species or forms (6):

Bembidion schmidti azoricum
Trechus torre-tassoi
Bradycellus chavesi
Calathus extensicollis
C. lundbladi
C. vicenteorum

(4) Palaeo-endemic species (2):

Bembidion derelictum
Agonum aptinoides

Comments on the Historical Groups:

Group 1. Of the 11-17 species here regarded as introduced, 9 have been brought by man from Europe to North America (Lindroth, 1957), thereby demonstrating their ability for this kind of transport above all in the ballast of the old sailing vessels.

For the remaining species certain arguments are available pointing in the same direction: —

Bembidion ambiguum (a flightless species) was found once only, in the same place (Praia in Terceira) and apparently on the same day as the obviously introduced *Licinus punctatulus*.

Harpalus distinguendus is a pronouncedly synanthropic species but, curiously enough, is lacking on the British Isles. This is probably the reason why it was not brought to North America but of course did not prevent it from being carried to the Azores from Portugal, whence most introduced forms of the Azorean fauna no doubt emanated.

Harpalus ardosiacus and *Stenolophus teutonus* are often found on ground strongly influenced by human culture. The latter was found on a ballast-place in southern England (Lindroth, 1957, p. 195).

Acupalpus brunneipes, *Bradycellus distinctus* and *Dromius meridionalis* are not found on the other Macaronesian islands, which gives their distribution pattern an «unnatural» touch. *Dromius* may very well have been carried over with timber.

Of the 17 species, at most, referred to this group all occur on the Ibe-

rian Peninsula and two only (also *Bembidion ambiguum)* are lacking on the British Isles.

Group 2. The 7 species supposed to have immigrated by the air are all winged forms, except that in *Microlestes negrita* some individuals are brachypterous.

Calosoma olivieri is an excellent active flyer. Examples of long-range dispersal in other species of the same genus are the repeated captures of *C. sycophanta* L. (regarded as an immigrant even in northern Germany) in Sweden (Lindroth, 1945, p. 339) and the find of a single ♀ of the southern *C. lecontei* Cki. (*lugubre* Lec.), otherwise unknown in Canada, at Duparquet in northern Quebec (Calif. Ac. Sci. Museum). The lack of *C. olivieri* in Madeira is however unexpected.

Human transport is perhaps not totally excluded for any of the remaining 6 species of this group but they apparently all occur in Madeira, 3 or 4 of them also in the Canaries.

Pterostichus aterrimus and *Agonum marginatum* are less likely to have been carried by ship because they are very pronounced hygrophiles and these are known to be little suited for human transport (Lindroth, 1957, p. 199).

Group 3. Turning to the endemic species and forms, it is well worth to recall that all 8 of them have rudimentary hind-wings, except the subspecies *azoricum* of *Bembidion schmidti* for which, however, the ability of flight is slightly dubious.

The 6 forms here termed «neo-endemics» all have close relatives on other Macaronesian islands and/or on the mainland of SW Europe and N. Africa: —

Bembidion schmidti azoricum: other subspecies in Madeira and the Canaries, in N. Africa and SW Europe.

Trechus torre-tassoi: in Madeira (*T. flavomarginatus*, etc.)

Bradycellus chavesi: *B. distinctus* of SW Europe, N. Africa and the Azores themselves.

The 3 *Calathus* spp.: *C. mollis* of W Europe and N. Africa.

It must be assumed that these 5 species, and the single subspecies, though developed on the Azores, are not very old. At least the 3 *Calathus* may be descendants of one or two winged ancestors, like *C. mollis f. typ.* of present time.

Group 4. *Bembidion derelictum* and *Agonum aptinoides* take a position of their own and are here called «palaeo-endemic». Neither of them is close-

ly allied to any other species known. They are highly brachypterous and their entire habitus (narrow shoulders, etc.) is stamped by the flightless condition. Though absence of functioning wings is always something secondary in Carabid beetles, that is, they are all descendants of full-winged ancestors, these, in the two cases here treated, must be looked for well back in Tertiary time.

Otherwise the number of indigenous Carabid species found on the Azores is too low to make allowance for well-founded speculations concerning the history of the fauna.

A Comparison with the Madeiran Fauna

The extreme faunal poverty of the Azores is in itself a most interesting problem, impressively contrasting against the abundance of peculiar, in part no doubt very old endemics of Madeira and the Canaries.

On Madeira (incl. Porto Santo and the Desertas, but excl. the Salvages) the number of Carabid species, as compiled from the recent list of Lundblad (1958), amounts to 88. Of these 43 are endemic species, that is 49 per cent, including the most interesting endemic genus *Elliptosoma*, related to *Loricera*. The modest number of 32 species on the Azores, including only 7 endemics, that is 22 per cent, is a remarkable contrast indeed.

It seems to me that this striking faunal difference between the Azores and Madeira cannot be understood without taking several different factors into consideration that alone or, more probably, by combined effect may offer an explanation.

Conditions of Existence

(1) An unfavourable climate may have prevented more fastidious species from settling and developing on the Azores. Confining the discussion to present climatic conditions, a comparison with Madeira is illustrated by the diagram in fig. 17. It is evident that the differences in temperature, expressed as monthly average, are unimportant, almost non-existing in the there summer months and not amounting to more than 1.5° C. in any part of the minter. — The precipitation is similarly distributed through the year in both island groups, with a marked summer minimum, but this is far more pronounced in Madeira, where July and August are almost completely dry.

The comparatively met summer of the Azores has a clear influence on the flora and fauna as emphasized by Frey (1943), among others. Not only

are xerophilous species underrepresented in the Azorean fauna, but the constant high humidity causes a general levelling of abiotic (in particular the microclimatic) conditions, with a pronounced poverty (decreased variation) of biotopes as last consequence. It is quite possible that a species, though having arrived, may have failed to settle on the Azores because of scarcity or total lack of its right habitat, while in Madeira it was able to do so.

If N. Africa is regarded as probable starting area for most insects reaching the Macaronesian islands by over-sea dispersal, it should also be remembered that they would be forms adapted to a still more «Mediterranean» climate than that prevailing in Madeira, which may be close to the limit of what they are able to endure in the way of «oceanity».

(2) Earlier conditions may have been different and unfavourable in the Azores. The still very active volcanic processes of the islands may have been more disastrous to flora and fauna than in Madeira. I find this explanation plausible though hypothetical. This applies even more to the idea that parts of the islands may have been flooded either by tectonic movements or by a general rise of the sea-level, for instance during the Pleistocene glaciations. It should be considered in that connection that Pico (2320 m.) on the Azores is higher than Madeira (1950 m:) and also that Flores, inhabited by the «palaeo-endemic», flightless *Bembidion derelictum*, as well as by old floral elements, is a comparatively low island (942 m.).

I am completely at a loss to decide if a lower geological age could be responsible for the reduced number of endemites on the Azores. At any rate it does not explain the poor representation of more wide-spread forms (24, against 45 in Madeira, among the Carabidae).

Conditions of dispersal.

(3) Madeira is in a far more favoured position for receiving over-sea colonists among the insects.

Distance. The geographical isolation of the Azores is a clear obstacle to presumptive immigrants. The distances to the nearest mainland are:—

Azores (São Miguel)	— —	Portugal (Cabo da Roca)	ca. 1400 km.
» (Santa Maria)	— —	Morocco (Cap Cantin)	ca. 1500 km.
Madeira (Porto Santo)	— —	Portugal (Cabo San Vicente)	ca. 800 km.
» (Desertas)	— —	Morocco (Cap Sim)	ca. 600 km.
Canaries (Fuerteventura)	—	W. Africa (Cabo Yubi)	ca. 100 km.

Now dispersal through the air, with which we are concerned for the

moment, is not directly correlated with the distance between the mainland and the island in question. Comparing two islands the chances for immigration (leaving aside other factors) ought to be in reverse proportion to the square figure of distance.

Using the figures given above and counting the «index of dispersal» from Morocco to the Madeira-group (600 km.) as 100, we receive the following indices: —

Morocco — Azores, 16	Portugal — Madeira, 56
Portugal — Azores, 18	Morocco — Madeira, 100

W. Africa — Canaries, 3600.

«Catching area». It is however necessary to consider also the surface of the compared islands. This is their approximate «catching area», in case the islands are surrounded by high-salinity water, because this exerts a disastrous desiccating effect upon insects floating on the surface of the sea (Palmén, 1944, p. 154 a.f.). Islands situated in lakes or surrounded by brackish water, on the other hand, possess a «catching area» widely exceeding their own surface, because insects arrived by «anemo-hydrochorous» transport are successfully contributing to the stock of immigrants.

In the actual case the wider «catching area» gives some compensation in favour of the Azores, with a total area of 2340 km.^{2}, against 770 km.^{2} for Madeira, that is, the Azores should possess a three times larger «catching area» than Madeira. According to this the chances of dispersal from Portugal would be exactly the same (index 56) for both groups of islands, but about twice as favourable to Madeira (100 against 48) in a direction from N. Africa. (The Canaries are not considered here and in the following.)

«Catching angle». The discussion so far has been implicitly based on the assumption that insects, actively flying or wind-borne over the sea, finally drop down and are distributed completely at random, on land or into the sea. This cannot be true. An island must be supposed to catch more air-transported insects than any equal area of the surrounding sea: (a) because they do no doubt drop down more frequently on the lee-side of land than anywhere else[1]; (b) because on a more or less calm and hot day they are absorbed by convective currents formed over land (provided they are not transported at too high an altitude)[1]; (c) because most fly-

1) Points (a) and (b) increase in importance with altitude and size of the island.

ing insects, in moderate wind, are not moving at random but able to direct themselves towards land; that many species are able to distinguish between land and water already well above the surface, is clear from the regular wing-borne migration between a dry winter and a wet summer habitat, for instance in many Carabids (Lindroth, 1943 b, p. 125 a. f.; H. Krogerus, 1948, p. 141 a.f.). Libellulids, hawk-moths, several Calosomas among Carabids, etc., are able to force even rather strong winds.

If land as a rule attracts a flying insect more than water, as here emphasized, a successful transport to a selected island is influenced, besides distance, not by its size in the first place, but rather by its «catching angle», as calculated from the point (or area) from which the dispersal is supposed to start.

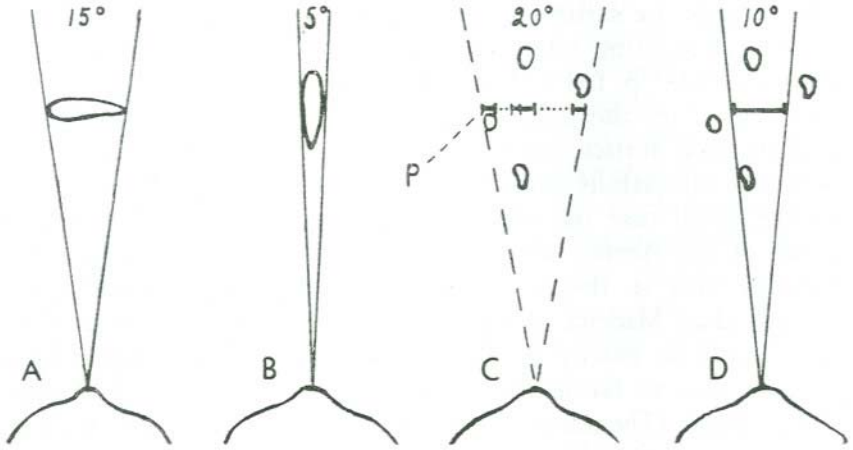


Fig. 1. The «catching angle» of islands. **A** & **D**, single island in different exposures; **C** & **D**, Archipelago; **C**, seeming angle, **D**, angle regarded as real and calculated on line of projection, «p».

In the actual case, comparing the Azores with Madeira, the «catching angles» have been calculated as follows: —

From Portugal (Cabo da Roca)	towards	the Azores	4.5°
» » (Cabo San Vicente)	»	the Madeira group	2.5°
» N. Africa (Cap Cantin)	»	the Azores	1.6°
» » (Cap Sim)	»	the Madeira group	2.5°

If we use «catching angle» instead of «catching area» (cf. above) combined with the square figure of distance for calculating an «index of dispersal» that seems closer to realities, and still counting the chances Morocco - Madeira as 100, the indices are: —

Morocco — Azores 10	Portugal — Madeira 56
Portugal — Azores 33	Morocco — Madeira 100

This calculation, above all, is marred by one severe imperfection: dispersal does not start from a point but from a continent. It could thus be supposed that the long African shore-line might have played a greater role as faunal contributor to these islands than the shorter Iberian coast, notwithstanding the distance, «catching area» and «catching angle». As the two island groups in this respect have a similar geographical position, the method used may however be justifiable.

The estimated difference could be expressed as follows: if the present fauna of the Azores and of Madeira is regarded as the exclusive result of dispersal through the air (which, indeed, it is not!), it could be expected that Madeira would be inhabited by between three and four times as many species as the Azores.

(4) The direction of prevailing winds and the sea-currents may have favoured dispersal to one of the two island groups compared.

The winds have been neglected in the preceding paragraph because conditions are similar around both island groups. The direction particulary facilitating dispersal from the continent is prevailing in summer when these latitudes are influenced by the N.E. trade (*vide* e.g. Hann, 1911, p. 122). The Azores are however situated close to the northern limit of the trades and Madeira has a better position for receiving a transport of insects this way. Frey (1943, p. 16) thinks that the reverse antitrade, above the trade, is responsible for transportation of insects and other kinds of «aerial plancton» in these latitudes, to which I cannot agree. The investigations of Glick (1939), to which he refers, show a rapid decrease of air-borne insects above the 200 m. level. Persistent winds near the surface, like the trades or the west-winds of the southern hemisphere, are no doubt able to produce long-range dispersal at least as successfully as air-currents stamped by the dangerously low temperatures of high altitudes. And this must be true first of all of organisms adapted to the warm regions of the world.

The Atlantic sea-currents surrounding the Macaronesian islands are

extremely unfavourable for surface transport of living beings throughout the year. It is the so-called Canarien Current, a returning part of the Gulf-stream system directed from the north and northwest. No appreciable difference in situation between Madeira and the Azores exists in this respect.

(5) Conditions of dispersal may have been different in the past, during periods of different distribution of land and water in the Mid-Atlantic. This is the famous Atlantis problem which I am not qualified to discuss (*vide* abstract of literature by Lundblad, 1947). The only remarks I am prepared to make are, (a) that there is no reason to believe that the Azores and Madeira had a different history as far as possible land-connections are concerned, and (b), that the composition of rhe Macaronesian faunas cannot be explained by any kind of continental drift (in the Wegenerian sense). If these islands are remnants of a suture along which the American continents were joined to the Old World, this situation must have occurred so long ago that the biological consequences cannot be traced. The Azores, situated farthest west, would be the islands expected most to house a bi-continental element, but the very few American insect species now present on the islands are doubtless introductions (Mèquignon, 1935; Frey, 1943, p. 20).

SUMMARY

The different composition of the Carabid fauna of the Azores and of Madeira, particularly the pronounced faunal poverty of the first-named islands, may be explained by the combined effect of climate and chances of dispersal (distance, prevailing winds, etc.), under the assumption that conditions similar to those of the present time have been ruling during a sufficiently long period in the past. An earlier more devastating effect of volcanic powers on the Azores may have contributed. The Azorean fauna in itself, at least as far as Carabid beetles are concerned, does not seem to make the hypothesis of a former land-connection with the other Macaronesian islands or with the adjacent mainland necessary.

Bibliography

Alluaud, C.:

1891. Coléoptères recueillis aux Açores par M. J. de Guerne pendant les campagnes du yacht L'Hirondelle, (1887-1888). *Mém. Soc. Zool. France.* Paris, p. 197-207.

1919. Contribution à l'étude des Carabiques d'Afrique et de Madagascar (Col.). XXI. Note sur diverses espèces des Canaries et des Açores, dont deux nouvelles, et description d'un genre nouveau. *Bull. Soc. Ent. France* (1918). Paris, p. 251-254.

1926. Notes sur les Carabiques. III. Description d'un Bembidion des Açores et notes sur la faune des Iles de l'Atlantique. *Ibidem.* Paris, p. 11-13.

Bedel, L.:

1895-1914. Catalogue raisonné des Coléoptères du nord de l'Afrique, etc. I. *L'Abeille.* 28-31. Suppl. Paris, p. 1-325.

Breuning, S.:

1927. Monographie der Gattung Calosoma Web. I. *Koleopt. Rundschau,* 13. Wien, p. 129-232.

Burakowski, B.:

1957. A morphological and taxonomical study of the Central European species of the subgenus Acupalpus Latr., etc. *Fragm. Faun.* 7:13. Warszawa, p. 297-357.

Colas, G.:

1938. Note, sur deux Calathus des Açores. *Bull. Soc. Ent. France.* Paris, p. 73-76.

1939. Voyage de MM. L. Chopard et A. Méquignon aux Açores (Aout-Septembre 1930). XII. Coléoptères: Carabidae. *Ann. Soc. Ent. France,* 108. Paris, p. 41-48.

Crotch, G. R.:

1867. On the Coleoptera of the Azores. *Proc. Zool. Soc. London,* p. 359-391.

1870. Coleoptera. In: F. du C. Godman, Natural history of the Azores or Western Islands. London, pp. I-VII, 1-358.

Dejean, P. F. M. A.:

1829. Species général des Coléoptères. 4. Paris, p. 1-520.

Drouet, H.:

1859. Coléoptères Açoréens. *Revue & Mag. Zool. pure & appl.* (2). 11. Paris, p. 243-259.

1861. Èléments de la faune açoréenne. Paris, p. 1-245.

Frey, R.:

1943. Azorerna i biogeografins ljus. *Årsbok Soc. Scient. Fenn.* 21. B: 4. Helsingfors, p. 1-27.

Fuente y Morales, J. M. de la:

1918-21. Catalogo Sistematico-geografico de los Coleopteros en la peninsula iberica, etc. *Bol. Soc. Ent. España,* 1-3. Zaragoza.

Glick, P. A.:

1939. The distribution of insects, spiders and mites in the air. *U.S. Dept. Agric., Techn. Bull.* 673. Washington, D. C., p. 1-150.

Hann, J.:

1911. Handbuch der Klimatologie. III: 2. (3. ed.). Stuttgart, pp. I-IX, 1-713

Heer, O.:
1860. Ueber die fossilen Calosomen. Zürich.
Holdhaus, K.:
1912. Monographie der paläarktischen Arten der Coleopterengattung Microlestes. *Denkschr. Math. — Naturw. Klasse K. Ak d. Wiss.* 88. Wien, p. 477-540.
Holion, A.:
1941. Faunistik der deutschen Käfer. I. Wien, p. 1-463.
Jeannel, R.:
1937. Nouveaux Trechinae paléarctiques. *Bull. Soc. Ent. France.* Paris, p. 82-88.
1938. Die Arthropodenfauna von Madeira nach den Ergebnissen der Reise von Prof. Dr. O. Lundblad Juli-August 1935. V. Coleoptera: Carabidae. *Ark. f. Zool.* 30 A: 10. Stockholm, p. 1-18.
1940. Les Calosomes. *Mém. Mus. Nat. d'Hist. Nat.* (N. S.). 13:1. Paris, p. 1-357.
1941-42. Coléoptères Carabiques. 1-2. *Faune d France.* 39. 40. Paris, p. 1-1173.
Kolenati, F.:
1845. Meletemata Entomologica. I. Insecta Caucasi, etc. Petropolis (Leningrad), p. 1-88.
Krogerus, H.:
1948. Oekologische Untersuchungen über Uferinsekten. *Acta Zool. Fenn.* 53. Helsingfors, p. 1-153.
Lindroth, C H.:
1939-40. Zur Systematik fennoskandischer Carabiden. 4-12. Bembidion-Studien. *Notulae Ent.* 19. Helsingfors, p. 63-99.
1943a. Zur Systematik fennoskandischer Carabiden. 13-33. *Ent. Tidskr.* 63. Uppsala, p. 1-68.
1943b. Oodes gracilis Villa. Eine thermophile Carabide Schwedens. *Notulae Ent.* 22 (1942). Helsingfors, p. 109-157.
1945, 1949 Die fennoskandischen Carabidae. I. III. *Gbgs. K. Vet. Vitt. Samh. Handl.* (6) B. 4. Göteborg, pp. 1-709, 1-911.
1957. The faunal connections between Europe and North America. Stockholm p. 1-344.
Lundblad, O.:
1947. Makaronesien und Atlantis. Eine historisch-biogeographische Uebersicht. *Zool. Bidr.* 25. Uppsala, p. 201-323.
1958. Die Arthropodenfauna von Madeira nach den Ergebnissen der Reise von Prof. Dr. O. Lundblad Juli-August, 1935. XXXV. Die Käferfauna der Insel Madeira. *Ark. f. Zool.* (2) 11:30. Stockholm, p. 461-524.
Méquignon, A.:
1935. Coléoptères americains acclimatés aux Açores. *Bull. Soc. Ent. France.* 40. Paris, p. 203-204.
1942. Voyage de MM. L. Chopard et A. Méquignon aux Açores (Aout-Septembre 1930). XIV. Catalogue des Coléoptères Açoreens. *Ann. Soc. Ent. France* 111. Paris, p. 1-66.
Monte, T. de:
1943. Contributi alla conoscenza dei Bembidiini paleartici. I. Specie affini al B. (Peryphus) nitidulum Marsh. *Boll. Soc. Ent. Ital.* 75. Genova, p. 1-11.
1952. IV° contributo alla conoscenza dei Bembidiini paleartici. *Mem. Soc. Ent. Ital.* 31:1. Genova, p. 83-95.
Müller, G.:
1931. Carabiden-Studien (2. Fortsetzung). *Coleopt. Centralbl.* 5. Berlin, p. 41-78.
1933. Carabiden-Studien. IV. Teil. *Koleopt. Rundschau.* 19. Wien, p. 201-221
Netolitzky, F.:
1916. Die Verbreitung von Ocys harpaloides Serv. *Ent. Blätter.* 12 (appendix). Berlin.

1942-43. Bestimmungstabelle der Bembidion-Arten des paläarktischen Gebietes. *Koleopt. Rundschau.* 28 (1942), p. 29-124. 29 (1943), p. 1-70. Wien.

Palmén, E.:
1944. Die anemohydrochore Ausbreitung der Insekten als zoogeographischer Faktor, etc. *Ann. Zool. Soc. Zool.-Bot. Fenn. Vanamo.* 10. Helsingfors, p. 1-262.

Peyerimhoff, P. de:
1931. Mission scientifique du Hoggar. Coléoptères. *Mém. Soc. Hist. Nat. Afr. N.* 1:2. Alger, p. 1-173.

Putzeys, J.:
1873. Monographie des Calathides. *Ann. Soc. Ent. Belg.* 16. Bruxelles, p. 19-96.

Schatzmayr, A.:
1937. I Calathus d'Europa. *Pubbl. Mus. Ent. «P. Rossi».* 2. Duino, p. 1-54.
1940, 1943. Appunti Coleotterologici. IV. X. *Riv. Sci. Nat. «Natura».* 31. 34. Milano, pp. 80-84, 132-139.

Schatzmayr A. & C. Koch:
1934. Tachys Steph. Ris. sci. Spediz. Ent. Torre e Tasso, etc. IV. *Boll. Soc. Adr. Sci. Nat. Trieste.* 33. Udine, p. 1-23.

Schauberger, E.:
1926, 1928, 1930a. Beitrag zur Kenntnis der paläarktischen Harpalinen. II. IV. VII. *Coleopt. Centralbl.* 1. 3. 4. Berlin, pp. 153-182, 65-85, 169-218.
1930b, 1933. Zur Kenntnis der paläarktischen Harpalinen. VI. IX. *Koleopt. Rundschau.* 15. 18. Wien, pp. 193-209, 49-64.
1935. Harpalinae (Carab., Col.). In: Visser, Karakorum. Leipzig, p. 276-277.

Tarnier, F.:
1860. Insectes Coléoptères. In: A. Morelet, Iles Açores. Notice sur l'hist. natur. des Açores, etc. Paris, p. 1-216.

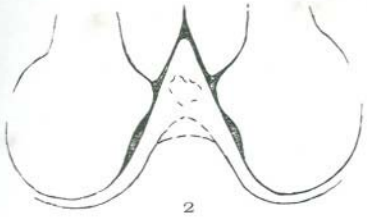
Uyttenboogaart, D. L.:
1947. Coleoptera (excl. Staphylinidae et Hydrophilidae) von den Azoren und Madeira. *Comm. Biol. Soc. Scient. Fenn.* 8:12. Helsingfors, p. 1-15.

Wollaston, T. V.:
1854. Insecta Maderensia, etc. London, pp. I-XLIII, 1-634.
1864. Catalogue of the Coleopterous Insects of the Canaries, etc. London, pp. I-XIII, 1-648.
1865. Coleoptera Atlantidum, etc. London, pp. I-XLVII, 1-526, 1-140 (Appendix).

Figs. 2-3. *Bembidion derelictum* Alluaud (♂ «co-type»). (2) Metasternal process between the middle coxae; (3) *penis* (clove-oil slide), G = flagellum, S = stylet.

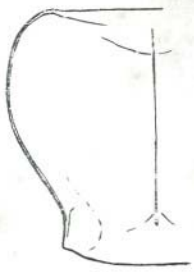
Figs. 4-5. Prothorax of (4) *Bemdidion schmidti* Woll. *s. str.* («co-type», Madeira): (5) *B. schmidti azoricum n. sbsp.* (allo-type, São Miguel). Punctuation omitted.

Fig. 6. *Agonum aptinoides* Tarnier (♂ «co-type»). Penis (clove-oil slide).

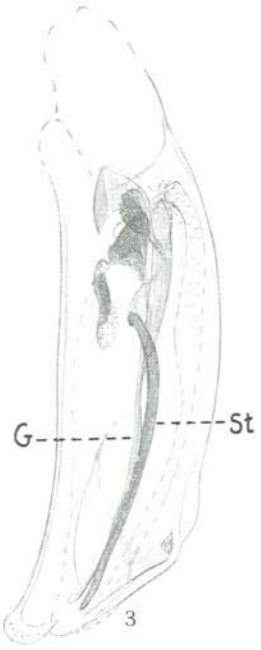


2

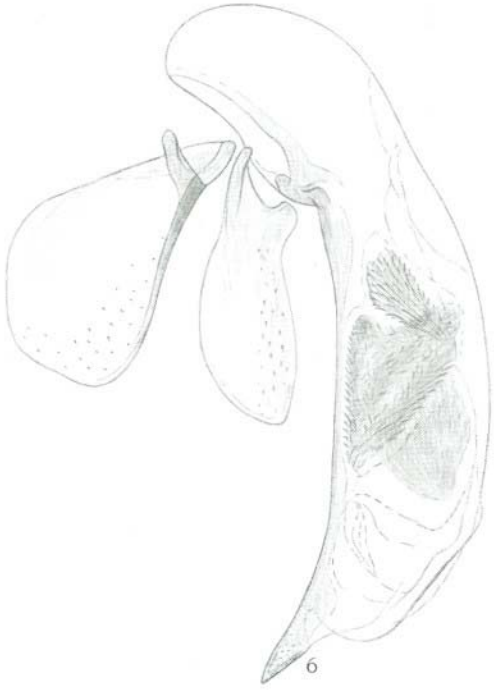
4



5



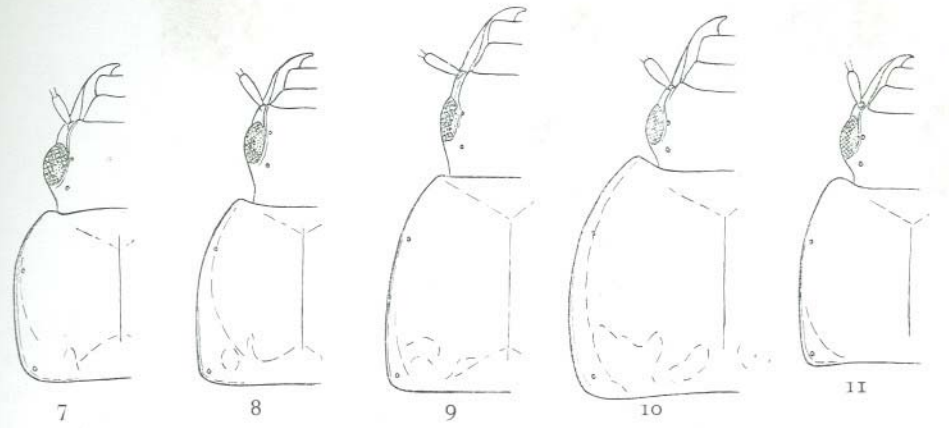
3



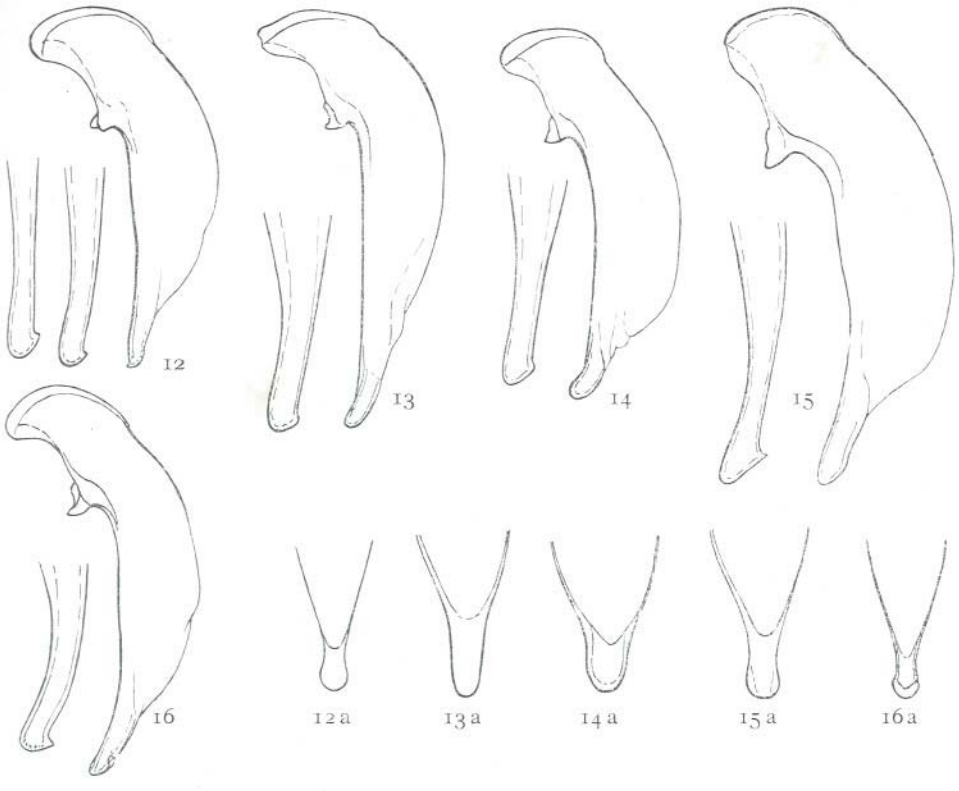
6

Figs. 7-11. Prothorax of *Calathus*. (7) *C. mollis* Mrsh. (♂, Appledore, N Devon, Engl.; broader than usual); (8) *C. lundbladi* Colas (♂ holo-type); (9) *C. vicenteorum* Schatzm. (♀ holo-type); (10) *C. extensicollis* Putz. (♀, Pico, Brit. Mus.); (11) *C. simplicicollis* Woll. (♂ «co-type», Canaries, Lanzarote).

Figs. 12-16. *Calathus*. Penis in side view and apex of right paramere (larger scale), (a) dorsal view of penis apex. — (12) *C. mollis* Mrsh. (Appledore, N Devon, Engl.; paramere of 2 exx.); (13) *C. lundbladi* Colas (São Miguel, Brit. Mus.); (14) *C. vicenteorum* Schatzm. (Santa Maria, Mus. Lund); (15) *C. extensicollis* Putz. (Pico, Brit. Mus.); (16) C. *simplicicollis* Woll. («co-type», Canaries, Lanzarote).



7 8 9 10 11



12 13 14 15 16

12a 13a 14a 15a 16a

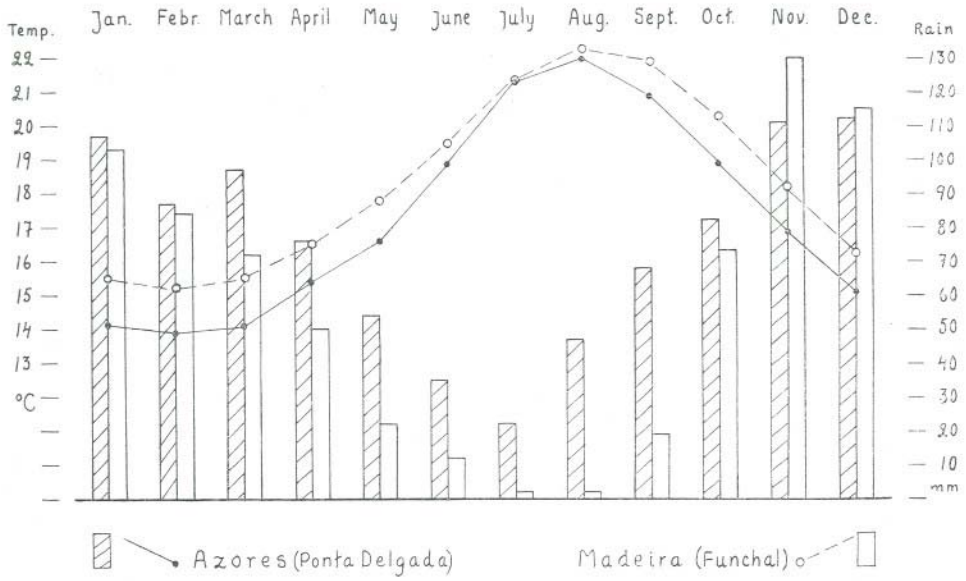


Fig. 17. Monthly average at sea-level of temperature (curve) and rain-fall. (According to figures given by Hann, 1911.)